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A PRAGMATIC REVIEW ON ALGORITHMIC APPROACHES FOR DISASTER MANAGEMENT USING WIRELESS SENSOR NETWORKS

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ABSTRACT

World is an occurrence ground for the fiascos practically every day. These occurrences of mass annihilation independent of the whether common catastrophes or man-made calamities cause a colossal misfortune of cash, property and lives because of non-anticipating the piece of the legislatures and the administration orgs. In this manner steps are obliged to be taken towards the avoidance of these circumstances by deciding ahead of time the reason for these catastrophes and giving brisk salvage measures once the catastrophe happens. Remote Ad hoc sensor systems are assuming a key part in remote information transmission framework and might be extremely useful in these circumstances. Remote sensor systems use the advances which can result in a caution for the prompt salvage operation to start, at whatever point this catastrophe is struck. Through this examination work our point is to survey innovative answers for overseeing fiasco utilizing remote sensor systems (WSN) by means of debacle discovery and cautioning framework, and inquiry and salvage operations. We have initially talked about the fundamental building design of WSNs that might be useful in catastrophe administration and the remote sensor system displays that could be utilized for the diverse calamity circumstances. At long last, we will propose how these frameworks might be viable in worldwide situation which lingers behind the created world in essential base civilities. In this paper, the survey of calamity administration and remote sensor systems is examined with diverse parameters and components.

Keywords - Disaster Management, Disaster Recovery in WSN, Wireless Sensor Networks

INTRODUCTION

A wireless sensor network (WSN) of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding [1][2].

In computer science and telecommunications, wireless sensor networks are an active research area with numerous workshops and conferences arranged each year [3].

APPLICATIONS AND DOMAIN OF WIRELESS SENSOR NETWORKS

AREA MONITORING - Area monitoring is a common application of WSNs. In area monitoring, the WSN is deployed over a region where some phenomenon is to be monitored. A military example is the use of sensors detects enemy intrusion; a civilian example is the geo-fencing of gas or oil pipelines.

HEALTH CARE MONITORING - The medical applications can be of two types: wearable and implanted. Wearable devices are used on the body surface of a human or just at close proximity of the user. The implantable medical devices are those that are inserted inside human body. There are many other applications too e.g. body position measurement and location of the person, overall monitoring of ill patients in hospitals and at homes. Body-area networks can collect information about an individual's health, fitness, and energy expenditure [4].

AIR POLLUTION MONITORING - Wireless sensor networks have been deployed in several cities (Stockholm, London and Brisbane) to monitor the concentration of dangerous gases for citizens. These can take advantage of the ad hoc wireless links rather than wired installations, which also make them more mobile for testing readings in different areas.

FOREST FIRE DETECTION - A network of Sensor Nodes can be installed in a forest to detect when a fire has started. The nodes can be equipped with sensors to measure temperature, humidity and gases which are produced by fire in the trees or vegetation. The early detection is crucial for a successful action of the firefighters; thanks to Wireless Sensor Networks, the fire brigade will be able to know when a fire is started and how it is spreading.

LANDSLIDE DETECTION - A landslide detection system makes use of a wireless sensor network to detect the slight movements of soil and changes in various parameters that may occur before or during a landslide. Through the data gathered it may be possible to know the occurrence of landslides long before it actually happens.

WATER QUALITY MONITORING - Water quality monitoring involves analyzing water properties in dams, rivers, lakes & oceans, as well as underground water reserves. The use of many wireless distributed sensors enables the creation of a more accurate map of the water status, and allows the permanent deployment of monitoring stations in locations of difficult access, without the need of manual data retrieval.[5]

NATURAL DISASTER PREVENTION - Wireless sensor networks can effectively act to prevent the consequences of natural disasters, like floods. Wireless nodes have successfully been deployed in rivers where changes of the water levels have to be monitored in real time.

MACHINE HEALTH MONITORING - Wireless sensor networks have been developed for machinery condition-based maintenance (CBM) as they offer significant cost savings and enable new functionality.[6] In wired systems, the installation of enough sensors is often limited by the cost of wiring. Previously inaccessible locations, rotating machinery, hazardous or restricted areas, and mobile assets can now be reached with wireless sensors.

DATA LOGGING - Wireless sensor networks are also used for the collection of data for monitoring of environmental information; this can be as simple as the monitoring of the temperature in a fridge to the level of water in overflow tanks in nuclear power plants. The statistical information can then be used to show how systems have been working. The advantage of WSNs over conventional loggers is the "live" data feed that is possible.

WATER / WASTE WATER MONITORING - Monitoring the quality and level of water includes many activities such as checking the quality of underground or surface water and ensuring a country’s water infrastructure for the benefit of both human and animal.

STRUCTURAL HEALTH MONITORING - Wireless sensor networks can be used to monitor the condition of civil infrastructure and related geo-physical processes close to real time, and over long periods through data logging, using appropriately interfaced sensors.[7] Resultant data streams can be dynamically, or post (i.e. offline), analyzed to determine if potentially dangerous situations are arising, allowing for safety measures to be taken; including informing advance warning systems, and scheduling preventative maintenance.[8]

MAJOR CHARACTERISTICS OF WSN TECHNOLOGY

- Power consumption constraints for nodes using batteries or energy harvesting
- Ability to cope with node failures
- Mobility of nodes
- Communication failures
- Heterogeneity of nodes
- Scalability to large scale of deployment
- Ability to withstand harsh environmental conditions
- Ease of use

Sensor nodes can be imagined as small computers, extremely basic in terms of their interfaces and their components. They usually consist of a *processing unit* with limited computational power and limited memory, *sensors* or MEMS (including specific conditioning circuitry), a *communication device* (usually radio transceivers or alternatively optical), and a power source usually in the form of a battery. Other possible inclusions are energy harvesting modules,[9] secondary ASICs, and possibly secondary communication interface (e.g. RS-232 or USB).The base stations are one or more components of the WSN with much more computational, energy and communication resources. They act as a gateway between sensor nodes and the end user as they typically forward data from the WSN on to a server. Other special components in routing based networks are routers, designed to compute, calculate and distribute the routing tables.

PLATFORM, STANDARD, SPECIFICATION AND TECHNOLOGIES

Several standards are currently either ratified or under development by organizations including WAVE2M for wireless sensor networks. There are a number of standardization bodies in the field of WSNs. The IEEE focuses on the physical and MAC layers; the Internet Engineering Task Force works on layers 3 and above. In addition to these, bodies such as the International Society of Automation provide vertical solutions, covering all protocol layers. Finally, there are also several non-standard, proprietary mechanisms and specifications.

Standards are used far less in WSNs than in other computing systems which make most systems incapable of direct communication between different systems. However predominant standards commonly used in WSN communications include:

- ZigBee
- 802.15.4
- 6LoWPAN

HARDWARE ISSUES AND TECHNOLOGIES

One major challenge in a WSN is to produce *low cost* and *tiny* sensor nodes. There are an increasing number of small companies producing WSN hardware and the commercial situation can be compared to home computing in the 1970s. Many of the nodes are still in the research and development stage, particularly their software. Also inherent to sensor network adoption is the use of very low power methods for data acquisition.

In many applications, a WSN communicates with a Local Area Network or Wide Area Network through a gateway. The Gateway acts as a bridge between the WSN and the other network. This enables data to be stored and processed by device with more resources, for example, in a remotely located server.

SOFTWARE BASED DEPENDENCY IN WIRELESS SENSOR NETWORKS

Energy is the scarcest resource of WSN nodes, and it determines the lifetime of WSNs. WSNs are meant to be deployed in large numbers in various environments, including remote and hostile regions, where ad hoc communications are a key component. For this reason, algorithms and protocols need to address the following issues:

- Lifetime maximization
- Robustness and fault tolerance
- Self-configuration

Lifetime Maximization: Energy consumption of the sensing device should be minimized and sensor nodes should be energy efficient since their limited energy resource determines their lifetime. To conserve power the node should shut off the radio power supply when not in use.Some of the important topics in WSN(Wireless Sensor Networks) software research are:

- Operating systems
- Security
- Mobility

Operating systems for wireless sensor network nodes are typically less complex than general-purpose operating systems. They more strongly resemble embedded systems, for two reasons. First, wireless sensor networks are typically deployed with a particular application in mind, rather than as a general platform. Second, a need for low costs and low power leads most wireless sensor nodes to have low-power microcontrollers ensuring that mechanisms such as virtual memory are either unnecessary or too expensive to implement.

It is therefore possible to use embedded operating systems such as eCos or uC/OS for sensor networks. However, such operating systems are often designed with real-time properties.

TinyOS is perhaps the first [10] operating system specifically designed for wireless sensor networks. TinyOS is based on an event-driven programming model instead of multithreading. TinyOS programs are composed of *event handlers* and *tasks* with runto-completion semantics. When an external event occurs, such as an incoming data packet or a sensor reading, TinyOS signals the appropriate event handler to handle the event. Event handlers can post tasks that are scheduled by the TinyOS kernel some time later.

LiteOS is a newly developed OS for wireless sensor networks, which provides UNIX-like abstraction and support for the C programming language.

Contiki is an OS which uses a simpler programming style in C while providing advances such as 6LoWPAN and Protothreads.

RIOT implements a microkernel architecture. It provides multithreading with standard API and allows for development in C/C++. RIOT supports common IoT protocols such as 6LoWPAN, IPv6, RPL, TCP, and UDP.[11]

ERIKA Enterprise is an open-source and royalty-free OSEK/VDX Kernel offering BCC1, BCC2, ECC1, ECC2, multicore, memory protection and kernel fixed priority adopting C programming language.

SIMULATION OF WIRELESS SENSOR NETWORKS

At present, agent-based modeling and simulation is the only paradigm which allows the simulation of complex behavior in the environments of wireless sensors (such as flocking).[13] Agent-based simulation of wireless sensor and ad hoc networks is a relatively new paradigm. Agent-based modeling was originally based on social simulation.

Network simulators like OPNET, NetSim, NS2 and OMNeT can be used to simulate a wireless sensor network.

DISTRIBUTED SENSOR NETWORK AND SENSOR NETWORKS

If a centralized architecture is used in a sensor network and the central node fails, then the entire network will collapse, however the reliability of the sensor network can be increased by using a distributed control architecture. Distributed control is used in WSNs for the following reasons:

1. Sensor nodes are prone to failure,
2. For better collection of data
3. To provide nodes with backup in case of failure of the central node

There is also no centralized body to allocate the resources and they have to be self organized.

DATA INTEGRATION, SENSOR WEB AND WSN

The data gathered from wireless sensor networks is usually saved in the form of numerical data in a central base station. Additionally, the Open Geospatial Consortium (OGC) is specifying standards for interoperability interfaces and metadata encodings that enable real time integration of heterogeneous sensor webs into the Internet, allowing any individual to monitor or control Wireless Sensor Networks through a Web Browser.

To reduce communication costs some algorithms remove or reduce nodes redundant sensor information and avoid forwarding data that is of no use. As nodes can inspect the data they forward they can measure averages or directionality for example of readings from other nodes. For example, in sensing and monitoring applications, it is generally the case that neighbouring sensor nodes monitoring an environmental feature typically register similar values. This kind of data redundancy due to the spatial correlation between sensor observations inspires the techniques for in-network data aggregation and mining.

LITERATURE SURVEY / REVIEW OF EXISTING WORK

Wireless Sensor Networks for Disaster Management, Harminder Kaur, Ravinder Singh Sawhney, Navita Komal, International Journal of Advanced Research in Computer Engineering & Technology Volume 1, Issue 5, July 2012 : In this paper, the authors has proposed and analyzed the unique algorithmic approaches and techniques for the disaster management in multiple domains. The authors have critically analyzed various factors and remedies that can be used for removing any situation that can lead to any disastrous condition. Using the wireless sensor networks, the authors has proposed number of methods that can be used using the wireless sensor networks for avoidance of the disasters. Global climate change is increasing the occurrence of extreme climate phenomenon with increasing severity, both in terms of human casualty as well as economic losses. Authorities need to be better equipped to face these global truths. Efficient disaster detection and alerting system could reduce the loss of life and properties. In the event of disaster, another important issue is a good search and rescue system with high level of precision, timeliness and safety for both the victims and the rescuers. Recently, Wireless Sensor Networks (WSNs) have become mature enough to go beyond being simple fine-grained continuous monitoring platforms and become one of the enabling technologies for disaster early-warning systems. Event detection functionality of WSNs can be of great help and importance for (near) real-time detection of, for example, meteorological natural hazards and wild and residential fires.

Review on Wireless Sensor Network Protocol for Disaster Management, International Journal of Computer Applications Technology and Research, Volume 2 Issue 2, 2013: In this manuscript the authors has extracted number of domains and areas where the wireless sensor network can be used for the disaster management using different algorithms and protocols. The example as well as the case study of landsliding is explained that makes use of the wireless sensor networks in the avoidance and future predictions. Additionally, the authors has underlined air pollution monitoring as well as emergency response using wireless technology. The applications as well as remedial measures are very exceptionally explained by the authors of the paper.

Remote Sensing for Disaster Management, Marco Zennaro ICTP Italy 2013 : In this presentation and manuscript, the authors related the paradigm of wireless sensor network with disaster management. Using different architectures and diagrammatic approaches, the protocols and algorithms has been explained in multiple domains. Using low power 802.11 technology, the disasters and emergency situations can be very easily operated with the use of specific devices and paradigms.

Wireless Sensor Network for Flood and Water Level Monitoring System - Each year floods cause loss of thousands of lives and billions worth of property in India. Last year, major loss of human lives, cattle as well as billions worth of establishments was reported in the floods in Bihar and West Bengal. Each year both Ganga and Yamuna break their boundaries and cause numerous losses. Although all these losses cannot be eradicated fully but the losses to lives and property can be reduced to barest minimum level, if the protective measures can be taken before the disaster has struck in the form of flash floods. This can be made possible with the help of communication technology employed on top of wireless sensor networks. The system development involves the various phases and of course, all phases are equally important. Starting with the first phase of data collection, level one is to deal with the physical deployment of sensing devices in the riverbanks and implementation of an effective localization scheme depending on the situation and environment. The flow path of the river, past records of water flow and future prediction of the route of the river, influence the placements of the wireless sensors. These sensors form clusters to communicate with the local base stations. The local base stations are powerful enough to communicate with one another directly using wireless communications.

CONCLUSION

The paper is a collection of the summary of several other researches on the usage of wireless sensor networks for disaster management. WSNs are useful especially in monitoring or detecting possible natural disasters and reporting on it almost at real-time. However, this use also requires the networks to be as energy efficient as possible, to be accurate in reporting its location, and to endure the environment where it has been deployed and have a long lifetime.

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